

What is claimed is:

1. A manufacturing method of an optical device,

comprising the steps of:

preparing a cylindrical die unit, an outer circumferential surface of which is formed with a micro-asperity pattern;

preparing a substrate that is coated with a thin resin film;

holding the substrate by a transfer stage; and

forming a micro-asperity pattern on the thin resin film by pressing the outer circumferential surface of the die unit against the thin resin film with pressurizing means while rolling the die unit on the thin resin film.

2. The manufacturing method according to claim 1, wherein a temperature of a room is set lower than a melting temperature of the thin resin film, and wherein at least one of the die unit and the transfer stage is heated while control

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is so made that the thin resin film has a temperature that is lower than a heat decomposition temperature thereof.

3. The manufacturing method according to claim 1, further comprising the step of repeating the operation of rolling the die unit on the thin resin film.

4. The manufacturing method according to claim 1, further comprising the step of adjusting an angular deviation, from a rotation axis of the die unit, of a line connecting two alignment marks of the thin resin film that are located on both sides of the rotation axis of the die unit by rotating the substrate relative to the die unit in a state that the substrate is held by the transfer stage directly or indirectly.

5. The manufacturing method according to claim 1, wherein the micro-asperity pattern is formed on the thin resin film in an inert gas atmosphere.

6. The manufacturing method according to claim 1, wherein the micro-asperity pattern is formed on the thin resin

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film in a low-pressure atmosphere having a pressure that is lower than atmospheric pressure.

7. The manufacturing method according to claim 2, wherein the thin resin film is made of a thermoplastic material.

8. The manufacturing method according to claim 2, wherein the thin resin film is made of a thermosetting resin.

9. The manufacturing method according to claim 1, wherein the die unit has a portion having an inverted shape of a shape of an intended alignment mark that will serve as a positional reference when an optical element is disposed at a prescribed position with respect to the substrate, and wherein the alignment mark is press-formed on the thin resin film together with the micro-asperity pattern.

10. A manufacturing apparatus of an optical device, comprising:

a transfer stage for holding a substrate that is coated

with a thin resin film;

a cylindrical die unit, an outer circumferential surface
of which is formed with a micro-asperity pattern;

a moving mechanism for moving the transfer stage in a
direction that crosses a rotation axis of the die unit; and

a pressurizing mechanism for pressing the outer
circumferential surface of the die unit against the thin resin
film in such a manner that the die unit can rotate about the
rotation axis,

wherein a micro-asperity pattern is formed on the thin
resin film as the die unit rolls on the thin resin film while
being pressed against the thin resin film.

11. The manufacturing apparatus according to claim 10,
wherein the die unit comprises a stamper member for
press-forming the micro-asperity pattern on the thin resin
film and a roll body for holding the stamper member.

12. The manufacturing apparatus according to claim 10,

wherein the die unit comprises a stamper member for press-forming the micro-asperity pattern on the thin resin film, a roll body for holding the stamper member, and an elastic member interposed between the stamper member and the roll body.

13. The manufacturing apparatus according to claim 10, further comprising a heating unit for heating the die unit and the transfer stage, and a temperature control section for controlling the heating unit.

14. The manufacturing apparatus according to claim 10, further comprising a rotation axis direction moving mechanism for moving the transfer stage in a direction of the rotation axis of the die unit.

15. The manufacturing apparatus according to claim 10, further comprising a rotary moving mechanism for rotating the substrate in a plane that is located under the die unit and is parallel with the rotation axis direction of the die unit.

16. The manufacturing apparatus according to claim 10,

further comprising at least one alignment mark observation optical device provided in the pressurizing mechanism, for observing at least one alignment mark formed on the substrate.

17. The manufacturing apparatus according to claim 10, further comprising at least one alignment mark observation optical device provided under the substrate, for observing at least one set of a first alignment mark formed on the substrate and a second alignment mark formed on the die unit.

18. A manufacturing apparatus of an optical device, comprising:

a transfer stage for holding a substrate that is coated with a thin resin film;

a cylindrical die unit an outer circumferential surface of which is formed with a micro-asperity pattern;

a pressurizing mechanism for pressing the outer circumferential surface of the die unit against the thin resin film in such a manner that the die unit can rotate about a

rotation axis thereof,

a moving mechanism for moving one of the transfer stage
and the die unit;

an airtight chamber for accommodating at least the
transfer stage, the die unit, the pressurizing mechanism, and
the moving mechanism; and

exhausting means for exhausting a gas from the airtight
chamber prior to an operation that a micro-asperity pattern
is formed on the thin resin film as the die unit rolls on the
thin resin film while being pressed against the thin resin
film.

19. An optical device comprising:

a substrate; and

a thin resin film formed on the substrate, a top surface
of the thin resin film being formed with a micro-asperity
pattern and an alignment mark that will serve as a positional
reference when an optical component is disposed at a prescribed

position with respect to the substrate, the micro-asperity pattern and the alignment mark being formed by rolling, on an original resin film, a cylindrical die unit, an outer circumferential surface of which is formed with a micro-asperity pattern, and a portion having an inverted shape of a shape of the alignment mark while pressing the die unit against the original thin resin film.

20. The optical device according to claim 19, wherein the alignment mark has a first portion that allows observation light incident on the alignment mark to go to detecting means and a second portion that does not.

21. The optical device according to claim 20, wherein the second portion changes an optical path of part of the observation light incident on the second portion so that the part of the observation light does not reach the detecting means.